



Review

Management of obesity in patients with type 2 diabetes mellitus in primary care



Shoaib Mohammad^{a,*}, Jamal Ahmad^{b,1}

^a Alshifa Hospital, Delhi 110025, India

^b Centre for Diabetes & Endocrinology, Faculty of Medicine, J. N. Medical College Hospital, A.M.U., Aligarh 202 002, India

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ABSTRACT

Aims: Obesity and being overweight is the most powerful risk factor accounting for 80–90% of patients with type 2 diabetes mellitus (T2DM). The epidemic of obesity is driving the diabetes epidemic to alarming levels and primary care is becoming an important setting for obesity management in T2DM in India. Yet many primary care providers feel ill-equipped or inadequately supported to address obesity in patients with diabetes. This article reviews the most recent and strongest evidence-based strategies that may aid physicians in management of obesity in patients with T2DM in primary care.

Material and methods: A systematic literature search of MEDLINE using the search terms Obesity, Obesity in T2DM, weight loss and Primary Care was conducted. The American Diabetes Association, National Institute for Health, National Institute of Health and Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and World Health Organization websites were also searched. Most studies in this area are observational in design with few randomized controlled trials (RCTs). Articles and studies involving meta-analysis or RCTs were preferred over other types.

Results and conclusion: Effective weight management treatment in T2DM patient can be implemented in the primary care setting. Evidence based individualized lifestyle and pharmacologic measures supported by behavioral intervention and counseling with appropriate and informed surgical referrals has the potential to improve the success of weight management within primary care.

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* Corresponding author at: 22 – Gandhi Park, Press Enclave Road, Malviya Nagar, New Delhi 17, India. Tel.: +91 9999002661.

E-mail addresses: shoaibirfan@yahoo.co.uk (S. Mohammad), jamalahmad11@rediffmail.com (J. Ahmad).

¹ Tel.: +91 05712721544 (O); mobile: +91 09412459552.

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1. Introduction

Obesity is associated with a wide range of metabolic and cardiovascular conditions such as dyslipidaemia, atherosclerosis, hypertension and type 2 diabetes which also substantially increase the risk of stroke, angina and myocardial infarction. Obesity also predisposes to colon, breast, kidney and digestive tract cancers. In addition, non-life threatening disease states associated with obesity include arthritis, sleep apnea, gallstones and gout as well as low self-esteem and affective disorder [1].

Obesity and being overweight is the most powerful risk factor accounting for 80–90% of patients with diabetes [2]. Worldwide, at least 2.8 million people die each year as a result of being overweight or obese, and an estimated 35.8 million (2.3%) of global disability-adjusted life year (DALYs) are caused by overweight or obesity [3]. In India the overall prevalence was 6.8% and 33.5% for obesity and overweight respectively in a cross-sectional survey conducted in five different regions of India in 2007 [4]. One worrisome trend is that the age of onset of obesity is progressively getting younger [5]. Prevalence of overweight and obesity in 8–18 years old children in five urban cities in India was 18.5% and 5.3% respectively, in a recent multicentric cross-sectional study in 2011 [6].

2. Does weight loss improves health outcomes?

In more than 90,000 women studied there was a graded increase in the risk for death as body mass index (BMI) increased from normal levels to greater than 40 kg/m² [7]. Another study involving 83,744 male and female patients concluded mortality risk was directly related to BMI in patients less than 55 years of age [8]. Basically, the mortality and BMI have a J-shaped relationship.

A small amount of weight loss, approximately 10 kg, carries significant benefits including resolution of comorbid conditions [9] and 10% of initial weight loss has been shown to improve long-term comorbid control [10]. Table 1 lists some of the studies which demonstrate benefits of weight loss in improving health outcomes.

3. Obesity management in primary care – does it helps?

Even though evidence suggests that patients are considerably more likely to lose weight when they are advised to do so by their primary care physicians (PCP), most patients who are clinically obese do not receive weight-loss counseling in primary care [19,20]. Studies have provided evidence that PCP can deliver safe and effective weight loss interventions (Table 2).

4. Assessment and investigations for obesity

Comprehensive assessment is necessary to the effective management of obese patient. Table 3 enumerates the assessments necessary for management advice.

5. Assessment of severity of obesity

The patient should have weight, height, waist circumference measured and BMI calculated. The severity of obesity needs to be classified as per the WHO/IDF criteria – Table 4.

BMI (weight in kg/height in m²) is the most widely used parameter to assess obesity [25]. In view of the increased tendency for cardiovascular risk at lower BMIs, it has been proposed to lower these cutoffs to 23 kg/m² and 25 kg/m², respectively for Asian Indian [26]. BMI alone does not appear to accurately identify all cases of obesity, and this problem is most significant in individuals who may not appear particularly obese (i.e. BMI – 30 kg/m²) [27].

The WC seems to be clearly superior to BMI. In a study which followed a 11 year mortality in an Australian urban sample of 9309 adults aged 20–69 years, concluded that WC is superior in predicting CVD mortality than BMI with superior discrimination of risks compared to BMI [28]. Studies have shown that WC as a good correlate of abdominal visceral adipose tissue using computerized tomography and MRI [29]. WC is independent of height though IDF recommends ethnic specific criteria for variable frame size [30]. For individuals older than 75 years, a waist to hip ratio (WC divided by hip circumference) may be a better predictor of death than either BMI or WC alone [31]. Waist-to-hip ratios greater than 0.95 in men and 0.85 in women are considered elevated [31].

5.1. Assessment for potential causes of obesity

Tables 5 and 6 illustrate the possible conditions and medications which may be associated with weight gain and should be looked for in assessment through history and physical examination. A comprehensive drug history is essential to identify possible iatrogenic causes of obesity and determine whether these could be withdrawn, reduced or substituted [33].

5.2. Assessment of presence and risks of co-morbidities plus status of diabetes control and complications

This assessment would identify the co-morbidities, control of diabetes and its complications with the aim to optimize the treatment and assess the physical capability of the patient to undergo various modalities of obesity treatment (Tables 6 and 7) [33,34].

5.3. Assessment of patients lifestyle and motivation for change

Diet history: The patient's dietary habits need to be carefully documented. This information is best obtained by a dietician using techniques such as the 24-h recall, food frequency questionnaire and 3- or 7-day food frequency diaries [35]. Table 8 describes key information which could be elicited.

Physical activity (PA) history: Physical inactivity is also an independent risk factor for cardiovascular disease [36] and premature death [37]. Before advising patients for exercise to lose weight it is essential to know the present level of PA for individualized recommendations (Table 8).

5.4. Assessment of psychological status and motivational levels

All obese people should be screened for depression and anxiety, and specifically for eating disorders because all these conditions can impair the patient's quality of life and can also interfere with successful management [38]. Before starting the treatment the assessment of patient's motivation and readiness for change is

Table 1

Studies demonstrating benefits of weight loss in improving health outcomes.

Study	Brief details	Results
Diabetes Prevention Programme (DPP) [11]	3234 Participants with impaired glucose tolerance randomized to intensive lifestyle modification ($n = 1079$), metformin ($n = 1073$) or placebo ($n = 1062$). Mean follow-up was 2.8 years	The group receiving the lifestyle intervention achieved a 5.6 kg weight loss and a 58% reduction in the incidence of T2DM compared to the placebo control group The group that received the standard lifestyle recommendations plus metformin lost 2.1 kg and had a 31% reduction in the incidence of T2DM compared to controls
10 Years follow-up of DPP [12]	Lifestyle group regained weight partially	Compared to Placebo, 34% decrease in T2DM incidence was still present in lifestyle group and 18% decrease in metformin group
Framingham Study (2005) [13]	A total of 1228 over weight patients with weight loss were studied. 623 between 30 and 49 years of age and 605 between 50 and 65 years of age	A modest weight loss of 6.8 kg or more led to a 28% reduction in risk for hypertension among middle aged adults and a 37% reduction among older adults
Hypertension Prevention Research Group [14] Dattilo et al. (1992) [15]	Weight loss group, $n = 595$ was compared to the usual care group, $n = 596$. 70 Studies were analyzed in this meta-analysis	The Risk of hypertension reduced decreased by 65% in those who maintained their weight loss of 4.5 kg for 30 months Weight reduction was associated with significant decreases for TC , LDL-C , VLDL-C and TG A reduction in weight of 10 kg increased HDL by approximately 20% TGs were lowered 0.015 mmol/l for each kg of weight loss achieved with HDL increasing by 0.007 mmol/l Weight loss of 15% of body weight significantly decreased levels of CRP , tumor necrosis factor , and interleukin-6
Fisher et al. [16]	126 Healthy premenopausal women were studied with BMI of 27–30 kg/m ² for effects of exercise and weight loss on markers of Inflammation	
Fredheim et al. [17]	Compared effectiveness of a 1 year intensive lifestyle intervention to gastric bypass surgery on the prevalence and of Obstructive Sleep Apnoea (OSA) in a group of 133 morbidly obese patients	The average weight loss was 8% in the intensive lifestyle intervention group versus 30% in the gastric bypass group 66% of surgical patients versus 40% of lifestyle intervention patients experienced remission of OSA Weight loss rather than surgical procedure explains this beneficial effect
Look AHEAD (Action for HEAlth in Diabetes) [18]	This RCT involved 5145 overweight and obese patients with T2DM, participate in an intensive lifestyle intervention that promoted weight loss through decreased caloric intake and increased PA (intervention group) or to receive diabetes support and education (control group)	Terminated early after median follow up of 9.6 years because despite achieving significant weight loss and fitness gains, the intervention did not significantly reduce long term CV events compared to controls It did show that overweight individuals with T2DM can achieve long term weight loss 11% at one year and 7% at 4 years experienced remission of their diabetes particularly of those of more recent onset

Table 2

Trials studying the weight loss in primary care.

Trial	Brief details	Results
Wadden et al. [21]	3 Arms were compared in this RCT: 1. Usual care: counseling at quarterly visits at PCP clinic 2. Brief lifestyle counseling: monthly, 15 min in-person counseling visits by trained medical assistants 3. Enhanced lifestyle counseling: brief lifestyle counseling plus a tool box that contained meal replacements and weight loss medications	The enhanced lifestyle group lost significantly more weight at 2 years (4.6 kg) than those with either of two other groups and was more likely to lose at least 5% of their initial body weight
Appel et al. [22]	RCT involved participants from 6 primary care practices randomized into 3 physician supervised arms: 1. A self-directed weight loss program (control group) 2. In-person support: involving individual sessions plus group sessions, along with electronic and telephone contacts 3. Remote support: commercial call center directed group in which coaches delivered all lifestyle interventions by telephone, internet and emails	Weight loss at 2 years was similar in the groups receiving in-person support (5.1 kg) and remote support (4.5 kg) and was significantly greater than the weight loss in the control group (0.8 kg) Participants in in-person and remote group were twice as likely to lose 5% or more weight than the control group

RCT – randomized controlled trial.

Table 3

Assessment and investigations for obese patient.

<ul style="list-style-type: none"> Assess the severity of obesity – including the amount and distribution of fat if possible Potential cause of obesity should be considered Determine presence and risks of co-morbidities and/or complications. Evaluate patients lifestyle and motivational levels for change Finally – the Patient's suitability for various forms of treatment must be assessed in consultation with Patient and other team members (as available – Diabetes educator, Exercise/Physical educator/Dietician etc.)

crucial for the outcome of the obesity management. This can be done by using the American NHLBI clinical guidelines [39,40] (Table 9). Usually there is a marked mismatch between the patient's expectations and the reality of available weight-loss

treatment, especially those based on lifestyle and pharmacotherapy [41]. Unrealistic expectations will result in disappointment and frustration, even if clinically useful amounts of weight is lost [42].

After this comprehensive assessment of the patient we can plan the suitability of the patient to the various modalities of obesity management taking into consideration Severity of Obesity, the status of Diabetes control and complications, Co-morbid conditions and their control, present lifestyle, motivational levels and the current stage of change [43].

6. Treatment approaches

The cornerstones for a weight reduction program for obese patients with diabetes include a moderately hypocaloric diet, an increase in PA and behavior modifications.

Table 4
Guidelines for standard and modified classification of obesity by WHO/IDF [23,24].

Category	WHO definitions	Proposed WHO modified/IDF definitions for Asians (Indians)
BMI (kg/m ²)		
• Normal	18.5–24.9	18.5–22.9
• Overweight	25.0–29.9	23.0–24.9
• Obese	≥30	≥25
Waist circumference (WC) (for abdominal obesity)	(NCEP ATP III)	(IDF)
	Males > 102 cms	Males > 90 cms
	Females > 90 cms	Females > 80 cms
Obesity classes	(BMI kg/m ²)	Corresponding Asian Class
• Class I	30.0–34.9	25.0–29.9
• Class II	35.0–39.9	30.0–34.9
• Class III	≥40	≥35

Table 5
Causes of Obesity.

5.1 Causes of obesity [32]	5.2 Obesogenic drugs [32,33]
<i>Lifestyle related ('simple') obesity > 95% of all causes</i>	Glucocorticoids
• Genetic susceptibility	<i>Antidiabetic drugs</i>
• Obesogenic Lifestyle	• Insulin
<i>Obesogenic drugs (see panel 5.2)</i>	• Sulphonylureas and Glitinides
<i>Endocrine disorders</i>	• Thiazolidinediones
• Hypothyroidism	<i>Psychoactive drugs</i>
• Polycystic ovarian syndrome (PCOS)	• Antipsychotics
• Cushing syndrome	• Classical (chlorpromazine, haloperidol)
• Pituitary disease: panhypopituitarism, growth hormone deficiency	• Atypical (olanzepine, clozapine)
• Hypothalamic lesions	• Antidepressants (tricyclics)
<i>Inherited syndromes</i>	<i>Antiepileptic drugs</i>
• Prader-Willi syndrome	• Valproate
• Bardet-Biedl syndrome	• Carbamazepine
• Alström syndrome	• Gabapentin
<i>Monogenic disorders</i>	<i>Endocrine agents</i>
<i>Due to mutations affecting (rare and if suspected may need referral to higher center:</i>	• Progestogen-based contraceptives
• Leptin (LEP)	• Hormone replacement therapy
• Leptin receptor (LEPR)	• Tamoxifen
• Proopiomelanocortin (POMC)	<i>β-adrenoceptor blockers</i>
• Prohormone convertase 1 (PHC-1)	• Propranolol
• Neurotrophic tyrosine kinase receptor type 2 (NTRK2)	<i>Miscellaneous</i>
	• Cyproheptadine
	• Pizotifen
	• Flunarizine
	• Antihistamines
	• Cyclophosphamide
	• Fluorouracil

6.1. Dietary Interventions

A review of 34 randomized controlled trials (RCTs) concluded that an average weight loss of 8% can be obtained over six months with a 500–1000 kcal/day deficit diet, and this weight loss is associated with a decrease in abdominal fat [44]. Table 10 summarizes the outcomes of a meta-analysis of 29 studies with a follow-up period of at least 2 years [45].

Another meta-analysis looked at long-term efficacy of diets in 17 studies which included 3030 patients with a follow-up period of at least 3 years and an attrition rate of less than 50% (Table 11) [46].

Important evidence regarding dietary changes for obesity is further illustrated in Table 12.

Diet: Putting it all Together! Table 13 describes the proposed recommendations for Dietary guidelines based on above evidence.

Table 6
Obesity associated co-morbidities [33].

<i>Resulting from the metabolic effects of enlarged fat cells and visceral fat</i>
• Type 2 diabetes
• Hypertension
• Dyslipidemia (low HDL-cholesterol levels and high triglyceride levels)
• Cardiovascular disease (coronary artery disease, stroke, heart failure, and atrial fibrillation)
• Cancer (in men: liver, stomach, pancreas, esophagus, multiple myeloma, rectum, and gall bladder; in women: uterus, kidney, cervix, pancreas, esophagus, gallbladder, breast, liver, ovary, colon, and rectum)
• Gastrointestinal disease (GERD, erosive gastritis, gall bladder disease, gall stones, cholecystectomy, and nonalcoholic steatohepatitis)
• Kidney disease (kidney stones, chronic renal disease, and end-stage renal disease)
• Endocrine changes (hyperinsulinemia and insulin resistance, disturbed menstrual cycles, and altered cortisol metabolism)
• Infertility (the polycystic ovarian syndrome)
• Obstetrical risks (Cesarean section, hypertension, stillbirth, and neonatal mortality)
<i>Resulting from increased body mass</i>
• Bone and joint diseases (osteoarthritis and hospitalization for back disorders)
• Pulmonary disease (sleep apnea, pulmonary embolism, and sleep-disordered breathing)
• Social stigmatization

Table 7
Basic assessment for microvascular and macrovascular complications of T2DM for managing obesity.

<i>Assess for history of diabetes-related complications and investigate appropriately</i>
• Microvascular: retinopathy, nephropathy, neuropathy (sensory, including history of foot lesions; autonomic, including sexual dysfunction and gastroparesis)
• Macrovascular: CHD, cerebrovascular disease, and PAD
• Other: psychosocial problems, dental disease
• Review of previous treatment regimens and response to therapy (A1C records)
• Current treatment of diabetes, including medications, medication adherence and barriers thereto, meal plan, PA patterns, and readiness for behavior change
• Results of glucose monitoring and patient's use of data
• Review for Diabetes education history and Hypoglycemic episodes
<i>Physical examination (PE)</i>
• PE should be comprehensive and particularly look for (include as required all the systems)
• Blood pressure determination, including orthostatic measurements when indicated
• Fundoscopic examination
<i>Laboratory evaluation (not necessary if recent values present in most cases)</i>
• A1C, if results not available within past 2–3 months
• If not performed/available within past year
• Fasting lipid profile, including total, LDL, and HDL cholesterol and triglycerides
• Liver function tests
• Test for urine albumin excretion with spot urine albumin-to-creatinine ratio
• Serum creatinine and calculated GFR
• TSH

Adapted from ADA standards of Medical Care [34].

Table 8
Key information which may be elicited on present diet [35] and PA.

Diet
• The pattern of meals and snacks, including binges and nocturnal eating
• Timing, places and triggers of eating
• Types of food and frequency of eating them
• Portions size
• Drinks, especially sweetened and alcoholic beverages.
• Patient's level of understanding of nutrition and healthy eating (which will determine the level of diet counseling to initiate)
PA
• Current and previous levels of PA
• Time spent on sedentary activities such as watching television, Computer time etc.
• Transport to and from work/school
• Practical barriers to active transport (walking or cycling)
• Daily exercise or sport

Table 9

Patient readiness checklist formulated by the American National Heart, Lung and Blood Institute (NHLBI) to assess an obese subject's motivation and readiness for lifestyle change [39,40].

Motivation and support	
• How important is it for you to lose weight now?	
• Have you tried to lose weight before? Which factors led to success? What made weight loss difficult? (e.g. cost, peer pressure, no family support)	
• Is your decision to lose weight your own, or for someone else?	
• Is your family supportive?	
• Who, if anyone, supports your decision to lose weight?	
• What do you consider the benefits of weight loss?	
• What would you have to sacrifice? What are the disadvantages?	
Stressful life events	
• Are there events in your life now that might make losing weight especially difficult? (e.g. work responsibilities, family commitments)	
• If now is not a convenient time, what would it take for you to be ready to lose weight? When do you think you might be ready to begin losing weight?	
Psychiatric issues	
• What is your mood like most of the time? Do you feel you have enough energy to lose weight?(May need to assess for depression)	
• Do you feel that you eat what most people would consider a large amount of food in a short period of time? Do you feel out of control during this time? (May need to assess for binge eating disorders)	
• Do you ever make yourself vomit, use laxatives, or take excessive PA to control your weight? (May need to assess for bulimia nervosa)	
Time availability and constraints	
• How much time can you devote to PA per week?	
• Do you believe that you can make time to record how much you eat?	
• Can you take time out to relax and engage in personal activities?	
• Weight-loss goals and expectations	
• How much weight do you expect to lose?	
• How fast do you expect to lose weight?	
• What other benefits do you expect from losing weight?	
'Stages of change' model to assess readiness [43]	
Stage	Characteristic
Pre-contemplation	Unaware of problem, no interest in change
Contemplation	Aware of problem, beginning to think of changing
Preparation	Realizes benefits of making changes and thinking about how to change
Action	Actively taking steps toward change
Maintenance	Initial treatment goals reached

Table 10

Meta-analysis of diets in maintenance of weight: 29 studies with a follow-up period of at least 2 years [45].

	Follow-up (years)	Studies (n)	Weight loss (kg)	WLM (kg)	WLM (%)	Weight reduction (%)
All	4.5	13	14.0	3.0	23.4	3.15
Men	4.4	5	18.3	4.7	30.5	4.48
Women	4.4	6	16.6	4.66	23.6	4.67
VLCD	4.5	4	24.1	7.05	29.4	6.59
HBD	4.5	8	8.8	1.99	17.8	2.11
Low intensity exercise	2.7	6	22.0	7.47	27.2	6.66
High intensity exercise	2.7	6	20.9	14.99	53.8	12.49

HBD – hypoenergetic balanced diet; VLCD – very low-calorie diet; WLM – weight loss maintenance.

Table 11

Long term efficacy of diets. Median follow up 5 years (3–14 years) in 2131 patients (70%) and with maintenance of all weight loss or at least 9–11 kg of initial weight loss.

	WLM	Range
Initial weight loss (median)	11 kg	4–28 kg
Successful weight maintenance	15%	0–49%
Influence of initial treatment		
• Diet + Group Therapy	27%	14–31%
• Diet alone	15%	06–28%
• Diet + Behavior Therapy	14%	0–49%
Influence of energy level of initial diet		
• VLCD (300–600)	14%	6–49%
• Conventional Diet (800–1800 kcal)	18%	0–31%
Influence of intensity of follow-up		
• Active approach	19%	13–49%
• Passive approach	10%	0–31%
• VLCD + behavioral therapy + active follow-up	38%	27–49%

VLCD – very low calorie diet; WLM – weight loss maintenance.

Table 12

Studies with evidence on diet change for obesity.

Study	Results
NHLBI guidelines [44]	A review of 34 RCTs 6 concluded that an average weight loss of 8% can be obtained over six months with a 500–1000 kcal/day deficit diet, and that this weight loss is associated with a decrease in abdominal fat Predicted weight loss is 0.5–1 kg/week Unless accompanied by PA, weight loss through dietary modification alone does not appear associated with an improvement in cardiorespiratory fitness as measured by maximum oxygen consumption
McTigue et al. [47]	Review of 41 RCTs of at least one year in duration found that counseling to reduce caloric intake and increase PA reduced weight by approximately 3–5 kg Treatment is more successful with intensive therapy (defined as follow-up more frequently than monthly) and with multimodal interventions (diet, exercise and/or behavioral therapy).
Dasinger et al. [48]	Dietary therapy generally produces the greatest amount of weight loss within the first year, with 50% of the weight initially lost regained within the first three years
Saris [49]	Very low-calorie diets (VLCDs), generally involving the use of protein and dietary supplements and a caloric intake of 800 kcal/d or less, can produce greater initial weight losses than low calorie diets (LCDs), but long-term (>1 year) weight loss appears to be only marginally higher than LCDs. This diet should be done under medical monitoring
Nordmann et al. [50] Thomas et al. [51] Summerbell et al. [52]	The most important element of dietary therapy appears to be caloric restriction. Varying dietary macronutrient composition (e.g. low carbohydrate, low fat or low glycemic index) does not result in materially greater amounts of weight loss

6.2. Exercise interventions

PA alone does not appear to materially reduce weight but improves cardiorespiratory fitness, reduces abdominal fat and, in conjunction with dietary modification, assists with long-term weight maintenance [54]. Besides increasing energy expenditure and promoting fat loss, PA has additional benefits (Table 14) [55]. The exercise prescription should be individualized for the patient on the basis of the duration of diabetes, the initial fitness of the individual, their BMI and the length of time they have been

exercise training. The advice should include guidelines for endurance, resistance, and interval training, all of which have been shown to improve insulin sensitivity and glycemic control [56]. Table 15 lists the recommendations for exercise therapy [57].

6.3. Cognitive and behavioral approaches

Behavioral modification is the fundamental component of weight-loss treatment and has traditionally involved sessions focusing on dietary change, activity increase, and instruction in

Table 13
Recommendations for weight reducing diet in obesity.

Total energy	<ul style="list-style-type: none"> • 500–1000 kcal/day reduction (and a Calorie deficit) from usual intake • VLCD in general not recommended – would require medical monitoring and used only when more rapid weight loss is necessary • The impact of alcohol calories on the total caloric intake needs to be assessed and appropriately controlled
Total fats	<ul style="list-style-type: none"> • ≤30% of total calories • Fat-modified foods may provide a helpful strategy for lowering total fat intake but will only be effective if they are also low in calories and there is no compensation of calories from other foods • Saturated fat: 8–10% of total calories (reduce to <7% of total calories in patients with hypercholesterolaemia) • MUFA: Up to 15% of total calories • PUFA: Up to 10% of total calories • Cholesterol <300 mg/day (reduce to 200 mg/day in patients with hypercholesterolaemia)
Protein	<ul style="list-style-type: none"> • Approximately 15% of total calories • Proteins should be derived mainly from lean animal sources or plants.
Carbohydrates	<ul style="list-style-type: none"> • ≥55% of total calories • Mostly derived from complex carbohydrates • Limit intake of simple sugars (sugary drinks, sweets and foods sweetened with sucrose or fructose-rich corn syrup)
Fiber	<ul style="list-style-type: none"> • >15 g per 1000 kcal of energy intake • Present in vegetables, whole grains, legumes and fruits • A diet high in fiber promotes satiety at higher levels of calorie and fat intake and helps to reduce blood cholesterol
Salt	<ul style="list-style-type: none"> • <1000 mmol/day (equivalent to 6 g of sodium chloride) • Decrease added salt when cooking • Watch food labeling for salt content
Calcium	<ul style="list-style-type: none"> • 1000–1500 mg/day • During weight loss, adequate calcium intake should be maintained, especially in women at risk of osteoporosis

Adapted from [44,53].

Table 14
Additional benefits of exercise [56].

<ul style="list-style-type: none"> • Reduces abdominal fat and increases lean (muscle and bone) mass • May attenuate the weight loss-induced decline of resting energy expenditure • Reduces blood pressure and improves glucose tolerance, insulin sensitivity and lipid profile • Improves physical fitness • Improves compliance to the dietary regimen and has a positive influence on the long-term weight maintenance • Improves feeling of well-being, self-esteem and reduces anxiety and depression.

Table 15
Recommendations for exercise according to goal [57].

<i>For general health benefits</i>
<ul style="list-style-type: none"> • 30 min of moderate-intensity PA on most days of the week • Spread PA over at least 3 days per week, with no more than 2 consecutive days without exercise • At least 150 min of moderate aerobic activity (or at least 90 min of vigorous activity) per week are needed to improve cardiorespiratory fitness, weight control and glycaemic control in diabetic subjects
<i>To prevent weight gain and obesity</i>
<ul style="list-style-type: none"> • 60 min of moderate to vigorous activity on most days of the week • Activity can be spread through the day in bouts of 5–15 min
<i>For weight loss or maintaining weight loss</i>
<ul style="list-style-type: none"> • 60–90 min of moderate to vigorous activity each day • More exercise may be needed to maintain substantial weight loss

behavior change techniques. Table 16 tries to give evidence on the effectiveness of Cognitive-Behavioral Treatment (CBT). CBT includes several components such as goal setting, self-monitoring (e.g. dietary record), techniques controlling the process of eating, stimulus control as well as re-inforcement, cognitive and relaxation techniques [61]. Table 17 provides recommendations for CBT.

6.4. Pharmacotherapy

Comparatively few drugs are available for the treatment of overweight patients, and their effectiveness is limited to palliation of the chronic disease of obesity [63]. Only Orlistat is approved in India at present. Evidence for the use of pharmacotherapy is meager and they should not be considered without attempts at lifestyle changes. In RCTs of medications approved by USFDA combined with changes in lifestyle, in comparison with placebo

Table 16
Evidence of efficacy of CBT.

Study	Results
Shaw et al. [58]	Concluded that CBT, when added to diet and exercise interventions, produced superior weight losses (7.3 kg) than diet and exercise treatment alone (2.4 kg)
Painot et al. [59]	Investigated the efficacy of CBT plus diet and exercise interventions versus CBT alone in 70 overweight adults. Results indicated weight losses of 1.9 kg (standard deviation or SD = 0.6 kg) for the combined treatment group versus weight gain of 0.5 kg (SD = 0.6 kg) for the CBT-alone group at 3-month follow-up
Sbrocco et al. [60]	A study comparing CBT versus Behavioral Therapy (BT) weight loss interventions for 24 overweight subjects. Significant between group results ($P < 0.01$) indicated weight losses of 7 kg (SD = 2.0) and 10 kg (SD = 3.4) for CBT participants at 6 and 12 months, compared with 4.5 kg (SD = 2.6) and 4.3 kg (SD = 2.5) for the BT group

Table 17
Recommendations for cognitive behavioral therapy [55].

<ul style="list-style-type: none"> • CBT elements should form part of routine dietary management or, as a fuller, structured program, form the basis of specialist intervention • This care can be in part delivered in a group setting or through bibliotherapy using self-help manuals • CBT should be provided not only by registered psychologists but also by other trained health professionals such as physicians, dieticians, exercise physiologists or psychiatrists • CBT should include behavioral strategies like Goal setting, Self-monitoring, Stimulus Control, Changing the Environment, Problem solving and Relapse Prevention [62]
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and changes in lifestyle alone, it was found that the reduction in weight was 3–5% greater with the medications [53].

Tables 18 and 19 list the USFDA approved medications for the treatment of obesity-their mechanism, efficacy relative to placebo and adverse effects.

Recommendations for pharmacotherapy are summarized in Table 20.

6.5. Bariatric surgery

Bariatric surgery (BS) is the only treatment modality shown to provide consistent, sustained, long-term weight loss and for

Table 18

Anti-obesity medications and efficacy relative to placebo [64,65].

Medication	Mechanism	Weight loss (at one year relative to placebo)
Orlistat	Pancreatic lipase inhibitor causing excretion of approximately 30% of ingested triglycerides in stools	60 mg – –2.5 kg (–1.5 to 3.5) 120 mg – –3.4 kg (–3.2 to 3.6 kg)
Phentermine 15–37.5 mg	Noradrenergic causing appetite suppression	–3.6 kg relative to placebo
Diethylpropion 25 mg or 75 mg SR	Noradrenergic causing appetite suppression	–3 kg relative to placebo
Phendimetrazine	Noradrenergic causing appetite suppression	–3 kg relative to Placebo
Benzphetamine	Noradrenergic causing appetite suppression	Only few trials and possibly similar to other similar drugs
Lorcaserin 10 mg	Highly selective serotonergic 5-HT _{2C} receptor agonist causing appetite suppression	–3.2 kg (–2.7 to 3.8) relative to placebo
Phentermine plus Topiramate ER	Noradrenergic + GABA receptor activator, kainite/AMPA glutamate receptor inhibitor causing appetite suppression	7.5 mg/46 mg –6.7 kg (–5.9 to 7.5) 15 mg/92 mg –8.9 kg (–8.3 to 9.4)
Bupropion/naltrexone 90/8 mg	Acts on central pathways in hypothalamus causing appetite suppression	4–5 kg more than the placebo At 1 year 48% to 66% versus 16% to 42% of the placebo treated participants lost at least 5% of the initial body weight 10% of weight loss at 1 year occurred in 25–42% of patients on medications compared to 6–20% on placebo
Liraglutide	GLP-1 delays gastric emptying, increases satiety, and reduces food intake, and liraglutide has been shown to have the same effect	3.5 to 5.8 kg weight loss relative to placebo at 6–12 months

Table 19

Adverse effects observed with anti-obesity medications [65].

Medication	Adverse effects
Orlistat	Oily spotting, flatus with discharge, fecal urgency, fatty oily stool, increased defecation, fecal incontinence
Phentermine	Dry mouth, taste alterations, dizziness, tremors, headache, diarrhea, constipation, vomiting, gastrointestinal distress, anxiety, and restlessness
Diethylpropion	Similar to phentermine
Phendimetrazine	Similar to phentermine
Benzphetamine	Similar to phentermine
Lorcaserin	Headache, dizziness, fatigue, nausea, dry mouth, cough, and constipation; and in patients with type 2 diabetes, back pain, cough, and hypoglycemia
Phentermine plus Topiramate ER	Paresthesias dizziness, taste alterations, insomnia, constipation, dry mouth, elevation in heart rate, memory or cognitive changes
Bupropion/Naltrexon	Common side effects include nausea, headache, and vomiting. Other adverse effects reported in the label are Suicidal Behavior and Ideation, Neuropsychiatric Symptoms, Seizures, Increase in Blood Pressure and Heart Rate, Allergic Reactions and Angle-Closure Glaucoma
Liraglutide	There is a debate with safety concerns on incidence of Pancreatitis, Rodent studies have demonstrated dose-dependent and treatment duration-dependent thyroid C-cell hyperplasia and Tumors (though not seen in Humans)

Table 20

Recommendations for the Pharmacotherapy for Obesity [55,66].

- Current drug therapy is recommended for patients with a BMI ≥ 30 kg/m² or a BMI ≥ 27 with an obesity-related comorbid condition
- Pharmacotherapy should be considered as an adjunct to comprehensive lifestyle intervention to help achieve targeted weight loss and health goals
- Drugs should be used according to their licensed indications and restrictions
- Clinician should be knowledgeable about the product label
- The efficacy of pharmacotherapy should be evaluated after the first 3 months. If weight loss achieved is satisfactory ($>5\%$ weight loss in non-diabetic and $>3\%$ in diabetic patients), treatment should be continued
- Treatment should be discontinued in non-responders

decreasing or reversing obesity related comorbidities, such as type 2 diabetes (80%), dyslipidemia (70%), hypertension (75%), and obstructive sleep apnea (80%) in the morbidly obese population [67]. Table 21 tries to illustrate the impact of BS on comorbidities.

Apart from above BS has been associated with both prevention and improvement/resolution of obesity associated renal dysfunction, improvement in joint pains, arthralgia and osteoarthritis and significant improvement in psychological, Neurological and Sexual disorders [79].

Table 22 compares the recommendations of different guidelines for the position of BS in obesity treatment.

The proposed guidelines for Indian (South Asian) ethnicity (Table 23): Many guidelines recommend lower BMI cut-offs for the Indian patients, taking into consideration the higher CV morbidity and mortality at lower BMI [26].

Proposed recommendations for Indian Bariatric patients:

The recommendations in Table 24 are specific for the Indian (South Asian) ethnicity.

7. Summary of management of obesity in type 2 diabetes mellitus (T2DM) (putting the above evidence together!)

Table 25 presents a guide for deciding the level of treatment for a particular individual.

An Algorithm in Fig. 1 for the clinical pathway to treatment of obesity.

One of the most important point for the PCP is to know when to refer a patient to a specialized Obesity clinic. The PCP should have enough skills to counsel patients on each modality of the treatment including BS. Barriers to PA from pain due to chronic arthritis, back pain, and neuropathy should be evaluated, and treatments should be provided to help maintain the activity level necessary to sustain long term weight loss. Optimization of treatment comorbidities including diabetes, hypertension, dyslipidaemia etc. with individualized target based management as per local guidelines is necessary.

Contraindications specific for BS [Table 26]

8. Barriers to obesity treatment

Perceived barriers should be identified within primary care practice to ensure that strategies can be developed to prevent. Evaluation of potential barriers, such as socioeconomic status,

Table 21
Impact of BS on comorbidities.

Comorbidity	Impact of BS
Type 2 diabetes mellitus	<ul style="list-style-type: none"> The Swedish Obese Subjects (SOS) study, surgery compared with nonsurgical interventions, decreased the risk of developing diabetes by more than 3 times. There resolution of diabetes was 3 times more frequent at 10 years [68] Pories et al. found substantial and maintained long-term control of DM after RYGB in 121 of 146 patients (82.9%) with DM, and 150 of 152 patients (98.7%) with glucose impairment maintained normal levels of plasma glucose, glycosylated hemoglobin, and insulin [69]. Buchwald did a meta-analysis of all BS studies from 1990 to 2006 assessing type 2 DM resolution after BS found that 78.1% of diabetic patients had complete resolution, and diabetes improved or resolved in 86.6% of patients. Diabetes resolution was greatest for patients undergoing biliopancreatic diversion (BPD)/duodenal switch (95.1% resolved), followed by RYGB (80.3%), gastroplasty (79.7%), and adjustable gastric banding (AGB; 56.7%) [70]
Hypertension	<ul style="list-style-type: none"> The SOS study, showed a reduction of systolic blood pressure at 2 years in the surgical group [68] BS substantially improved and/or resolved hypertension in most patients (37–53%) or reduced the need for antihypertensive agents (18–36%) [71,72]
Hyperlipidaemia	<ul style="list-style-type: none"> Ten-year follow-up in the SOS study revealed [68] TG reduction was 18% after AGB, 15% after VBG, and 28% after RYGB The increase in HDL cholesterol was 20.4% after AGB, 23.5% after VBG, and 47.5% after RYGB TC reduction was 5% after AGB, 5% after VBG, and 12.6% after RYGB
Cardiovascular disorders	<p><i>Congestive Heart Failure</i></p> <ul style="list-style-type: none"> In patients undergoing BS with left ventricular ejection fraction (LVEF) less than or equal to 35%, mean LVEF at 6 months had significantly improved from 23% ($\pm 2\%$) to 32% ($\pm 4\%$) ($P=0.04$) with subjective and objective improvement in cardiac function [73] The benefits of BS on LV mass continue even when weight loss has stopped, and these effects may be caused by neurohumoral factors. These factors may contribute to improved long-term survival [74] <p><i>Coronary Heart Disease</i></p> <ul style="list-style-type: none"> Donadelli et al. reported a significant overall reduction of 10-year cardiovascular disease (CVD) risk starting 1 year after RYGB surgery, with a 1.1% reduction of absolute risk and a 2.3% reduction of percent risk as a result of surgery in patients being observed for 2 years after the operation [75] The SOS study found that BS seemed to be a safe and feasible treatment in improving cardiovascular risk factors and may be used as a strategy for secondary prevention in CVD [68]
Obstructive sleep apnoea	<ul style="list-style-type: none"> High rates of OSA resolution after BS have been shown in many studies [76] Continuous positive airway pressure (CPAP) use ceased in 52.9% of patients with OSA who had undergone SG at 1 year [77]. Two retrospective studies found complete resolution of OSA after BS in an Indian morbidly obese population at 1 or 3 years after surgery [76,78]

RYGP – Roux en-Y gastric Bypass, BPD – biliopancreatic diversion, AGB – adjustable gastric banding, VBG – vertical banded (or ring) gastroplasty.

Table 22
Compares the recommendations of different guidelines for the position of BS in Obesity treatment (Adapted from [80]).

	NIH (US)[81]	NHMRC (Australia)[82]	NICE (UK)[83]	European[84]	ADA[85]	SIGN (Scotland)[86]
Year	1991	2013	2006	2007	2010	2010
Eligible BMI	>40 kg/m ²	>40 kg/m ²	>40 kg/m ²	>40 kg/m ²	>40 kg/m ²	>40 kg/m ²
Eligible conditional BMI	35–40 kg/m ² with one serious weight loss responsive co-morbidity	35–40 kg/m ² with one serious weight loss responsive co-morbidity	35–40 kg/m ² with disease that could improve with weight loss	35–40 kg/m ² with one weight loss responsive co-morbidity	35–40 kg/m ² if control of diabetes and co-morbidity is difficult	>35 kg/m ² with one serious weight loss responsive co-morbidity
Comments	Outdated and of historic importance	Recognized use in <BMI 35 kg/m ²		Weight loss pre-surgery does not change eligibility	BMI < 35 kg/m ² insufficient evidence to date	

ADA – American Diabetes Association, NIH – National Institute of Health, NHMRC – National Health and Medical Research Council; NICE – National Institute of Excellence; SIGN – Scottish Intercollegiate Guidelines Network.

Table 23
BS guidelines for Indian/South Asian obesity patients.

<p><i>Recommendations by Asian Consensus meeting on Metabolic Surgery [80,87]</i></p> <ul style="list-style-type: none"> Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity with BMI more than 35 kg/m² with or without comorbidities Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity above a BMI of 32 kg/m² with comorbidities Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity above a BMI of 30 kg/m² if they have central obesity (waist circumference more than 80 cm in females and more than 90 cm in males) along with at least two of the additional criteria for metabolic syndrome: raised triglycerides, reduced HDL cholesterol levels, high blood pressure and raised fasting plasma glucose levels Any surgery done on diabetic patients with a BMI less than 30 kg/m² should be strictly done only under study protocol with an informed consent from the patient. The nature of these surgeries should be considered as yet purely experimental only as part of research projects with prior approval of the ethics committee <p><i>The IDF Position statement for BS (2011) [80]</i></p> <ul style="list-style-type: none"> In Asian, and some other ethnicities of increased risk, BMI action points may be reduced by 2.5 kg/m²

Table 24
Local recommendations for BS [80,87].

<ul style="list-style-type: none"> Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity with BMI more than 35 kg/m² with or without comorbidities Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity above a BMI of 32 kg/m² with comorbidities Bariatric/gastrointestinal metabolic surgery should be considered as a treatment option for obesity in people with Asian ethnicity above a BMI of 30 kg/m² if they have central obesity (waist circumference more than 80 cm in females and more than 90 cm in males) along with at least two of the additional criteria for metabolic syndrome: raised triglycerides, reduced HDL cholesterol levels, high blood pressure and raised fasting plasma glucose levels Any surgery done on diabetic patients with a BMI less than 30 kg/m² should be strictly done only under study protocol with an informed consent from the patient. The nature of these surgeries should be considered as yet purely experimental only as part of research projects with prior approval of the ethics committee
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Table 25

Guide for deciding treatment for Indian Patients (adapted from [26,55,80,83,87]).

BMI (kg/m ²)	Waist circumference in cm		Co-morbidities
	Men <90	Men ≥90	
	Women <80	Women ≥80	
23–24.9	L	L	L ± D
25.0–29.9	L	L ± D	L ± D
30.0–34.9	L ± D	L ± D	L ± D ± S
≥35	L ± D ± S	L ± D ± S	L ± D ± S

L=lifestyle intervention (diet and PA); D= consider drugs; S= consider surgery.

cultural beliefs, time constraints, lack of a support network, and professional obligations, need to be assessed [89]. Cognitive impairment, sleep disturbances, pain, chronic fatigue, immobility, cardiovascular disease, pulmonary function, and endocrine disorders may all limit a person's ability to understand and implement the lifestyle changes necessary to achieve long-term weight loss [89].

Only 50% of primary care practitioners counsel patients on obesity management. The barriers to counseling patients in weight loss include lack of time, patient noncompliance, inadequate reimbursement, limited teaching materials, and low confidence in surgery as a treatment option for obesity [90]. Educating primary

Clinical care pathway for overweight and obese adults

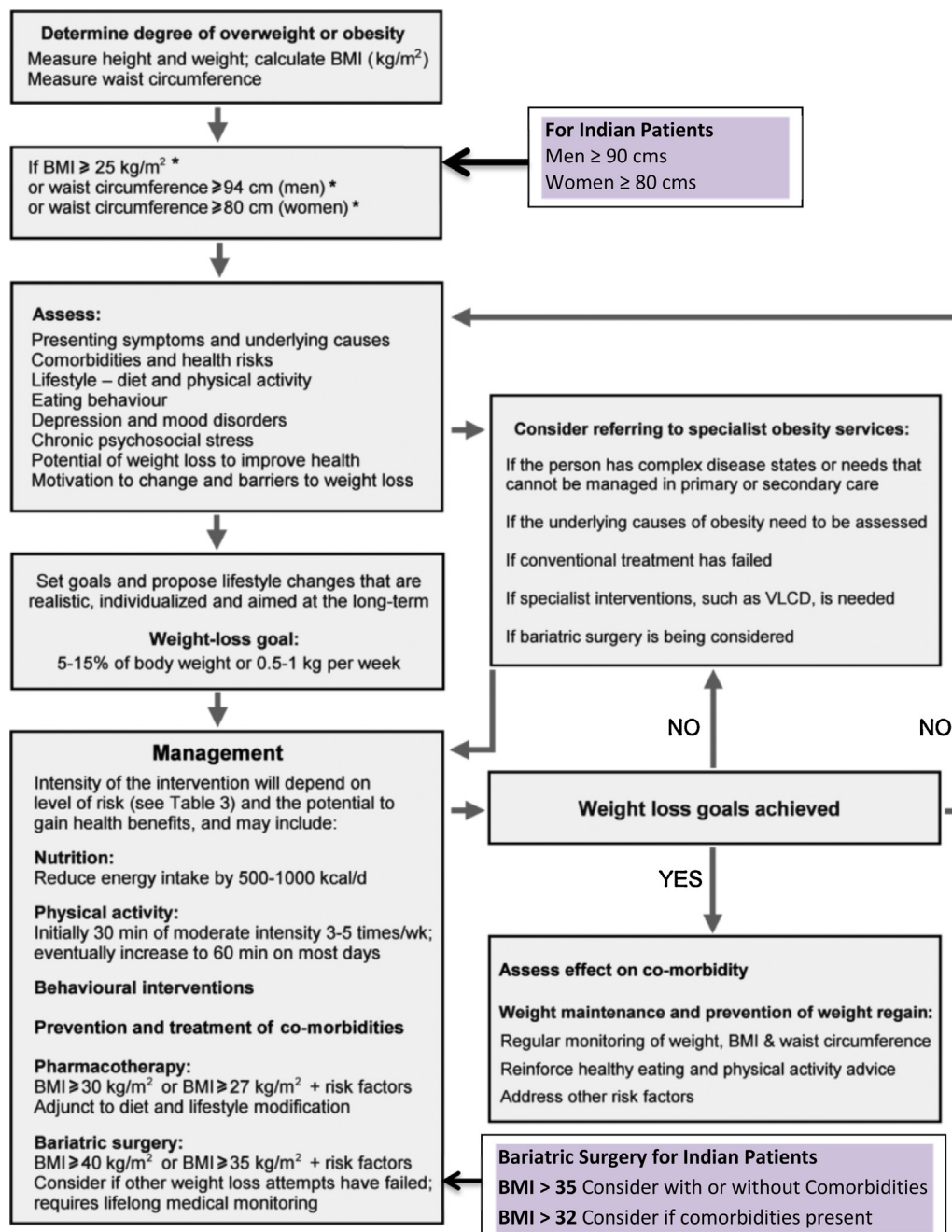


Fig. 1. Algorithm to treat obesity (Taken from [55] and adapted [87]).

Table 26
Contraindications specific for BS [88].

<ul style="list-style-type: none"> • Absence of a period of identifiable medical management • Patient who is unable to participate in prolonged medical follow-up • Non-stabilized psychotic disorders, severe depression, personality and eating disorders, unless specifically advised by a psychiatrist experienced in obesity • Alcohol abuse and/or drug dependencies • Disease threatening life in short term • Patients who are unable to care for themselves and have no long term family and social support that will warrant such care • Specific exclusion criteria for BS in the treatment of T2DM: <ul style="list-style-type: none"> • Secondary diabetes • Antibodies positive (anti-GAD or Islet Cell Antibodies) or C-peptide <1 ng/ml or unresponsive to mixed meal challenge
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care providers on obesity may decrease barriers to treatment and improve the care of this patient population.

Strategies for maintaining long term weight loss are essential and would include continued participation of the PCP and the patient in the weight loss program [91]:

- Engage in a high level of PA
- Eat a diet low in calories and fat
- Eat breakfast
- Self-monitor weight on a regular basis
- Keep a consistent eating pattern
- Catch “slips” before they turn into larger regains

9. Other treatment options (not included in these guidelines)

We have consciously not included procedures like Intragastrectic balloon, Transoral gastropasty and Duodenojejunal bypass sleeve which are being used in different countries. These procedures are either need widespread validation before being approved or they are still experimental [92].

10. Summary

Obesity is a highly prevalent chronic disease and an important risk factor for T2DM. Weight loss programs should focus on achieving realistic initial weight loss goals (e.g. 5–10%, of initial body weight) and should emphasize the need for weight maintenance. Weight reduction induced by lifestyle, pharmacologic or surgical measures supplemented with behavioral intervention has been shown to improve obesity related co-morbidities. Surgery is the only treatment that results in large amounts of weight loss and has become preferred therapy in medically refractory severely obese patients.

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